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March 17, 2020

Peter,

As discussed, please see the following data regarding the new water supply storage basin at Concord Country Club that will utilize existing wells. The more efficient irrigation system supplied by existing wells will have increased water distribution uniformity and efficiency and utilizing a new storage base, demand on well water will be reduced. The following is a overview of the existing/current well operation, how operation will change based on the proposed changes, and how the new pond/basin will be managed.

Current Well Operation:

- Wells are activated and provide flow based on the number of sprinklers operating (system demand). During peak system demand which is typically during the months of May-September, wells will operate at peak flow/output during the hours of 10:00 pm and 8:00 am. During this time both Well #1 and Well #2 will be operating at full available output and apply up to 120,000 gallons on average per day. Daytime operation is considerably less.
- Levels in wells are monitored electronically and remotely to view drawdown and if required, flow is reduced and time that it takes to water the course is extended proportionately.
- Total seasonal flow does not exceed the MA DEP registration for groundwater withdrawal amount of 25,680,000 gallons
- The average daily flow will not change with the new system installation and the new pumping scenario from a pond

Proposed Well Operation as a Resupply to the Pond:

- Wells will be activated by an electronic pond level sensor. When the pond draws down to a determined level, Well #1 will activate to replenish the pond. Should level continue to drop, Well #2 will be activated. This is exactly how the current system works.

- Flow from wells will be variable based on the set point of the exiting variable frequency drive (VFD) controls. Replenishment can now take up to 24 hours during peak use as opposed to current operation mode of 10 hours. This will reduce the burden on the wells and reduce the impact on the water table while providing the same gross volume.
- Well water will discharge into the pond onto a stone/rip-rap wash area to prevent run-off and erosion. Discharge will be at an area away from the new pump station intake in order to promote water movement and circulation.

New Pond, Pump Station, and Controls:

- The new pond shall act as a water holding basin/reservoir that will permit water to be taken at grater flow during the hours of 10:00 pm and 6:00 am. This will reduce evaporative losses associated with watering during daylight hours.
- Pond replenishment will be at a typical rate of 50% of current well operation.
- Pump station safety devices will allow detection of a system leak and will automatically turn off the irrigation system and notify the Course Management Team.
- New pump station will capture daily, monthly and yearly pumping totals.
- A weather station shall track wind speed, temperature, humidity, and solar radiation (sun intensity) that will allow for a calculated evapotranspiration rate (ET); the sum total of evaporation and plant transpiration (water used by the plan). This data will be used to automatically calculate sprinkler operating times so sprinkler application rates meet ET rates.
- Two tipping bucket rain cans will be installed on the property to measure rainfall. Upon Two tipping bucket rain cans shall be positioned on the property to measure rainfall. Upon 1/100th of an inch of precipitation, the irrigation system will activate a course “rain hold” and continue to monitor and measure rainfall. Rainfall totals will be compared to planned application rates and irrigation system will either cancel an irrigation event of rainfall exceeds plant requirements or, compare rainfall with planned application amount and adjust application amount as required.
- Chart shows new system and pumping capacities will reduce demand of water usage (next page). Due to better pumping capacity, more efficient sprinklers and being to accurately water where and when needed.

Pond Management:

- The pond shall capture surface drainage water and rainfall to supplement and reduce the demand for well water.

- The pond shall not be put into operation until April of 2021 which will allow for time to capture natural rainfall, snow, and run-off before wells are needed to supplement the pond. Wells will not operate during the winter and ponds will be allowed to drop below normal levels in anticipation of capturing off season rainfall, snow, and run-off.
- A pond aeration system will be installed to keep the pond from stagnating during times when there is no water use on the golf course and wells are not operating.
- Pond maximum fill levels will be two feet below the maximum capacity below overflow and will not exceed. Wells will shut off and will not operate until levels drop below threshold.

The attached table is a projected Annual Irrigation Requirement based on historical evapotranspiration and rainfall for the region. Rain fall was factored in at 33% of average annual precipitation.

If you have any questions or if I can be of any additional assistance, please do not hesitate to contact me.

Thank you,



Paul J. Roche, CID – Golf



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Annual Irrigation Requirement

Golf Course: Concord Country Club
Date: 8/29/18
Author: Roche

Plan # G0820
Revision Date: 3/17/20



Region (Rainfall)	Boston - NOAA
Region (ETo)	Boston - NRCC

Existing Turfgrass

Irrigation Days	20
Crop Coeff. (Kc)	0.80

	April	May	June	July	August	September	October	Totals
Historical Avg. Rainfall (in.)	3.28	2.90	2.51	2.76	2.91	2.95	3.42	20.73
Effective RF (%)	33%	33%	33%	33%	33%	33%	33%	33%
Effective RF (in.)	1.08	0.96	0.83	0.91	0.96	0.97	1.13	6.84
Historical Avg. ETo (in.)	1.95	3.09	3.58	4.02	3.49	2.29	1.36	19.78
Adjusted (Kc) ET (in.)	1.56	2.47	2.86	3.22	2.79	1.83	1.09	12.66
Irrigation Efficiency	85%	85%	85%	85%	85%	85%	85%	85%
Requirement (in.)	1.84	2.91	3.37	3.78	3.28	2.16	1.28	14.89
Moisture Deficit (in.)	0.75	1.95	2.54	2.87	2.32	1.18	0.15	11.78
Moisture Deficit (ft.)	0.06	0.16	0.21	0.24	0.19	0.10	0.01	0.98
Avg. Daily Def. (in.)	0.03	0.06	0.08	0.09	0.07	0.04	0.00	
Gallons/Month/Acre	20,444	52,984	69,001	78,006	63,117	32,090	4,111	319,754

Irrigated Acres	70
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Peak Use Per Cycle	0.14
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Monthly Totals	1,431,086	3,708,869	4,830,094	5,460,427	4,418,184	2,246,331	287,778
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Water Use/Irrig Event	273,021
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Annual Water Use	22,382,769
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Water Use Projection = $\frac{ETo \times Kc}{ER}$
Irrigation Efficiency

Ave. Rainfall = Average Rainfall (over 30 years) - NOAA

Irrigation Days = Number of irrigation days per month

Irrigation Efficiency = Efficiency for new irrigation system 85-90%
per Irrigation Association Recommendations

ETo = Regional and referenced historical evapotranspiration rates - Maximum Monthly - Northeast Regional Climate Center

Kc = Crop Coefficient - .8 for established cool season turfgrass 1.2 for Establishing Turfgrass - ET data is for Turfgrass
1.2 - Is based on Crop Coefficient (.80) x Crop Microclimate (1.2) x Crop Density (1.2)

ER = Effective Rainfall - 50% - Per Irrigation Association Recommendations (GW uses 33% during peak requirements)